

**McGRAW-EDISON**

**Onan**

# **Operators Manual**

**4.0 kW**

**BFA  
GenSet**

**RV Electric Generating Set**



**965-0122  
(SPEC C)**

4-81  
Printed in U.S.A.

# SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

**WARNING** Onan uses this symbol throughout this manual to warn of possible serious personal injury.

**CAUTION** This symbol refers to possible equipment damage.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

- **Use Extreme Caution Near Gasoline.** A constant potential explosive or fire hazard exists.

Do not fill fuel tank near unit with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve.

Fuel lines must be of steel piping, adequately secured and free of leaks. Use a flexible section of fuel line between generator set and stationary fuel line in the vehicle. This flexible section must be 100% NON-METALLIC to prevent electrical currents from using it as a conductor.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

- **Guard Against Electric Shock**

Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

Always use an appropriately sized, approved double-throw transfer switch with any standby generator set. **DO NOT PLUG PORTABLE OR STANDBY SETS DIRECTLY INTO A HOUSE RECEPTACLE TO PROVIDE EMERGENCY POWER.** It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power.

Use extreme caution when working on electrical components. High voltages cause injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

- **Do Not Smoke While Servicing Batteries**

Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

Be sure the unit is well ventilated.

- **Keep The Unit And Surrounding Area Clean**

Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Do NOT store anything in the generator compartment such as oil or gas cans, oily rags, chains, wooden blocks, propane tanks, etc. A fire could result or the generator set operation (cooling, noise and vibration) may be adversely affected. Keep the compartment floor clean and dry.

- **Protect Against Moving Parts**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

Do not work on this equipment when mentally or physically fatigued.

## TO THE OWNER

Welcome to the growing family of Onan Power users.  
... We are proud to have you as a customer.

Read this manual carefully and observe all safety rules within. Operating instructions, adjustments and periodic maintenance procedures are given so that you... the owner, can keep your unit running like new and expect many years of dependable service from it. Remember... any machine, regardless of design or type, will perform only in relation to the services it received.

If your generator set needs special attention, ask your Onan dealer for assistance; the Onan Parts and Service Organization has been factory-trained to provide up-to-date know-how for keeping your RV electric generating set "on the road".

## TABLE OF CONTENTS

General Information .....	2
Specifications .....	3
Installation Checks .....	4
Operation .....	6
Engine Troubleshooting .....	10
Maintenance .....	11
Assembly Torques .....	13
Periodic Maintenance Schedule .....	14
Adjustments .....	15
Control Troubleshooting .....	18
Remote Accessories .....	20

### **WARNING**

**TO PREVENT FIRE OR ACCIDENT HAZARD...  
THIS UNIT MUST BE INSTALLED ACCORDING  
TO THE MANUFACTURER'S DETAILED IN-  
STALLATION PROCEDURES OBSERVING ALL  
MINIMUM CLEARANCES.**

**TO AVOID POSSIBLE PERSONAL INJURY OR  
EQUIPMENT DAMAGE, ANY INSTALLATION  
AND ALL SERVICE MUST BE PERFORMED BY  
QUALIFIED PERSONNEL.**

# GENERAL INFORMATION

## YOUR MANUAL

This manual contains operation and other information to properly maintain, service, and make adjustments on your BFA generator set. Study and follow the instructions carefully. A well-planned service and maintenance program will result in longer unit life and better performance. Because the most important part of repair is diagnosis, a troubleshooting chart is included.

Throughout the manual, engine end of the generator set is the front. Left and right sides are determined when facing the engine (front) end.

When contacting your Onan dealer, distributor, or the factory about the generator set, always supply the complete model number and serial number as shown on the nameplate (see *Model Designation* following). This information is necessary to identify your generator set among the many types manufactured by Onan.

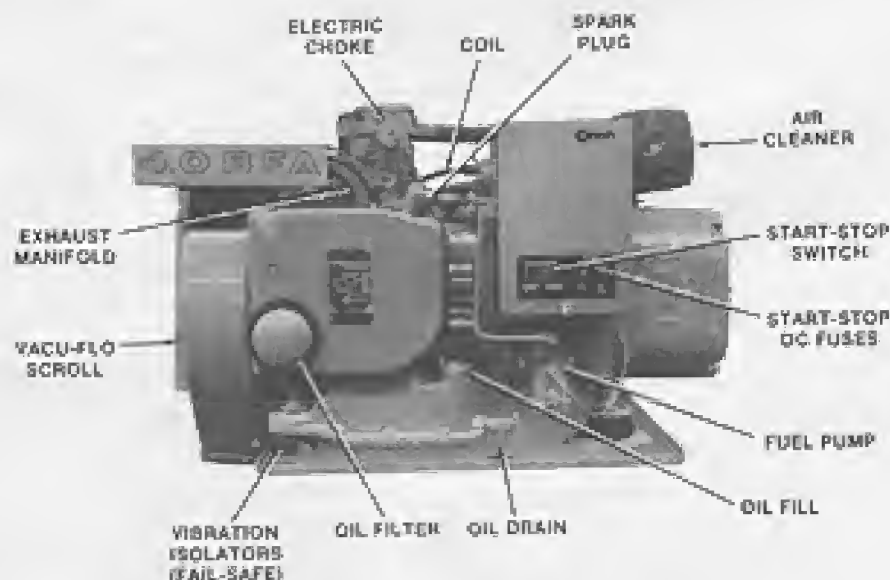
Onan electric sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Upon receiving your unit, check it thoroughly for any damage that may have occurred during shipping. Tighten loose parts, replace missing parts and repair any damage before operating the unit.

## MODEL DESIGNATION

The following typical model number is broken down into code segments used by Onan.

4.0	BFA	-	1	R	16004	B
↓	↓		↓	↓	↓	↓
1	2		3	4	5	6

1. Indicates kilowatt rating.
2. Series identification.
3. Number 1 is the voltage code for 120 volts single phase.
4. Method of starting: R-remote electric starting.
5. Factory code for designating optional equipment if any.
6. Specification letter which advances when the factory makes production modification.



TYPICAL BFA FOR RECREATIONAL VEHICLES



# SPECIFICATIONS

This manual contains SI metric equivalents that follow immediately in parentheses after the U.S. customary units of measure.

## GENERAL

### Nominal Dimensions of Set

Height .....	18.89 inch (480 mm)
Width .....	18.00 inch (457 mm)
Length .....	30.40 inch (772 mm)
Weight .....	235 lbs. (107 kg)

## ENGINE DETAILS

Manufacturer .....	Onan
Number of Cylinders .....	Two
Displacement (cubic inches) .....	43.30 (713 cm <sup>3</sup> )
Cylinder Bore .....	3.25 in. (82.55 mm)
Piston Stroke .....	2.62 in. (66.68 mm)
Compressions Ratio .....	7.0:1
Engine Speed .....	1800 RPM
Engine Design .....	Four Cycle, Air Cooled, L-Head Horizontally Opposed
Starting System .....	Exciter Cranking (Generator)

## GENERATOR DETAILS

Manufacturer .....	Onan
Design .....	Revolving Armature, Four Pole, 1800 RPM
Rating (in Watts) .....	4000 Watts (4 kW)
Voltage .....	120
Current Rating .....	
120 Volt .....	33.3 amperes
Phase .....	Single
Wire .....	2 Wire
Output Rating .....	Unity Power Factor
Cranking Current .....	75 amps

## CAPACITIES AND REQUIREMENTS

Oil Capacity .....	3 U.S. Quarts (2.8 lit) Plus 1/2 Quart for oil filter change
Recommended Battery .....	
Electric Start .....	12 Volt 74 amp/Hr (266.40 kC)
Battery Charge Rate .....	
Fixed .....	1-1 1/2 amps
Ventilation Requirements (Total) .....	80 sq. in. (516 cm <sup>2</sup> )

## TUNE-UP SPECIFICATIONS

Spark Plug Gap .....	.025 in. (0.64 mm)
Breaker Point Gap (cold setting) .....	.021 inch (0.53 mm)
Ignition Timing Reference (cold setting) .....	21° BTC
Valve Tappet Adjustment (engine cold) .....	
Intake .....	.003 in. (0.08 mm)
Exhaust .....	.010 in. (0.25 mm)

# INSTALLATION CHECKS

## INSTALLATION

Nearly all Onan electric generating sets are installed by the motor home manufacturer. Although the manufacturer must follow safety codes when installing, certain installation problems could arise after the unit is installed and subjected to vibration. There are a few areas that you as the operator should be concerned with. If in doubt about any aspect of your generator set's operation or safety, contact your nearest authorized Onan Service Center. A daily inspection of your installation should include the following:

## EXHAUST

Check for leaks around manifolds, gaskets, and welds. Make sure exhaust lines are not heating surrounding areas excessively. If so, have corrected immediately. Remember EXHAUST GASES CONTAIN DEADLY CARBON MONOXIDE. Be sure all holes to the inside of RV from set compartment are sealed to prevent poisonous exhaust gases from entering vehicles.

**WARNING** All exhaust shielding supplied with generator set MUST be properly installed to prevent overheating of compartment walls or the possibility of fire.

**WARNING** Do not terminate exhaust under vehicle, as carbon monoxide gas is poisonous. Direct exhaust gases away from window and door openings.

## FUEL SYSTEM

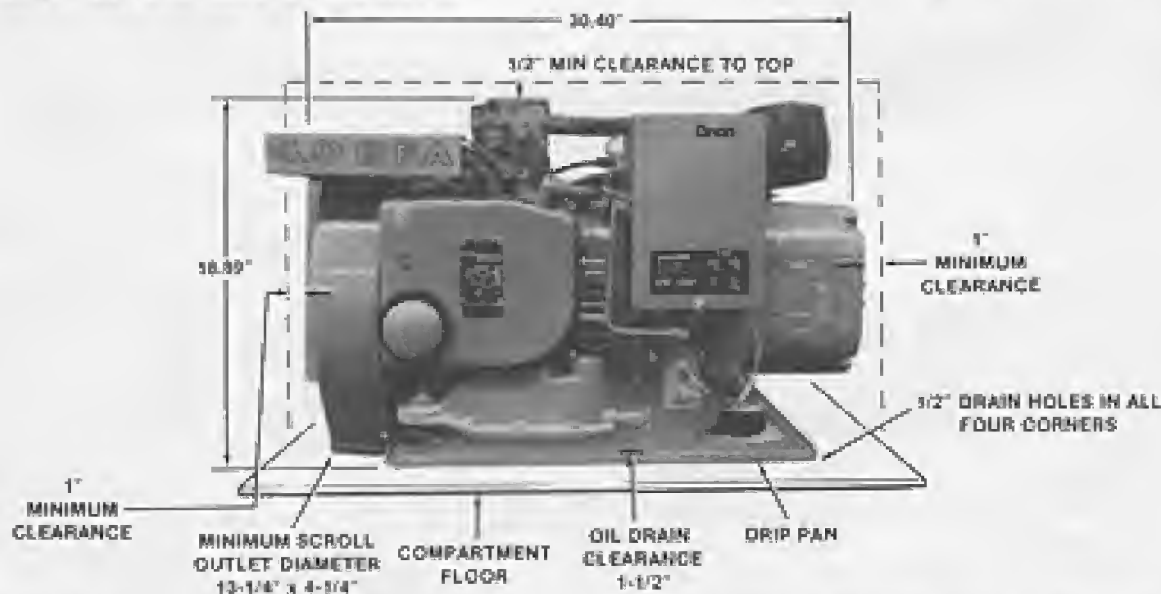
With set running, check for leaks. Raw fuel will cause fumes which could EXPLODE. Check around carburetor and fuel pump inlets. Make sure fuel lines are not rubbing against anything which could cause breakage.

## ELECTRICAL

### AC Output

Two AC leads, M1 (hot) and M2 (ground), terminate in generator junction box. These wires should be connected to distribution box with multistrand wire enclosed in a flexible conduit. Check all wires (to and from the generator set) for fraying and loose connections.

**Battery Connections:** Battery positive (+) connection connects to start solenoid. Battery negative connects to location on rear of generator. Check terminals on set and battery for clean and tight connections.



1. DIMENSIONS IN ( ) ARE MILLIMETERS
2. APPROX WEIGHT: 235 lbs., MASS: 107 kg
3. A 1.00" (25) MIN CLEARANCE REQUIRED AROUND SET AND .50 (13) MIN ABOVE CAB TO COMPARTMENT WALLS OR SOUND INSULATION (OIL FILTER MAY PROTRUDE INTO 1.60" (25) CLEARANCE
4. VACU-FLO SCROLL EXTENDS BELOW MOUNTING PLATE
5. FOR CUSTOMERS COMPARTMENT HOLE SIZE FOR SCROLL  
5.1 LENGTH: 13.25 (337)  
5.2 WIDTH: 4.25 (108)

FIGURE 1. INSTALLATION OUTLINE

Onan recommends using a separate battery for operation of the generator set in addition to the regular vehicle starting battery. Refer to individual installation guide or T-012 for additional information on battery sharing.

**Grounding:** Generator must be effectively bonded to recreational vehicle chassis.

For additional information on installation contact your Onan Service Representative or request Installation Guide #865-0612

Vehicle chassis (frame) ground and the battery and generator set ground should all be electrically connected to be at 0 ground potential. All Onan units are designed for negative ground application.

**WARNING** Mount the battery in a separate compartment from the set or any spark-producing device to prevent fire or explosion.

**WARNING** Do not smoke while servicing batteries. Lead acid batteries give off explosive gases while being charged.

**WARNING** DO NOT DISCONNECT BATTERY CABLES FROM BATTERY WHILE GENERATOR SET IS CRANKING OR RUNNING; SPARKS MAY CAUSE AN EXPLOSION.

**IMPORTANT:** Certain states (particularly California) have state ordinances pertaining to the type and usage of exhaust muffler/spark arresters on internal combustion engines or engine driven equipment when used in a recreational vehicle such as electric generating sets. Be sure your installation meets all Federal, State and local codes pertaining to your unit. Failure to provide and maintain a spark arrester may be in violation of the law.

## **WARNING**

### **ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!**

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

## **VENTILATION**

The biggest enemy of electric generating sets installed in motor homes is excessive heat. Make sure the set's air inlet and outlet are not plugged with dust, dirt, bugs, leaves or anything that could restrict cooling air.

**WARNING** Don't use discharged cooling air for compartment heating since it could contain poisonous exhaust gases.

**WARNING** Do not terminate exhaust under vehicle, as carbon monoxide gas is poisonous. Direct exhaust gases away from window and door openings.

**WARNING** On all listed models with exhaust shielding supplied with unit, shielding **MUST** be properly installed to prevent overheating of compartment walls or the possibility of fire. Refer to appropriate installation guide for each model for details.



# OPERATION

## BEFORE STARTING

**Inspection:** Inspect the engine visually before starting. Check for loose or missing parts or any shipping damage.

## CRANKCASE OIL

The set oil capacity is 3 U.S. quarts (2.8 lit) plus 1/2 quart for oil filter change. Fill the crankcase until the oil reaches the "FULL" mark on the oil level indicator (Figure 2). Do NOT OVERFILL. (Overfilling may cause foaming and engine shutdown.) Always change the oil filter when changing oil. Refer to *Periodic Maintenance Schedule* in *MAINTENANCE* section for service interval.

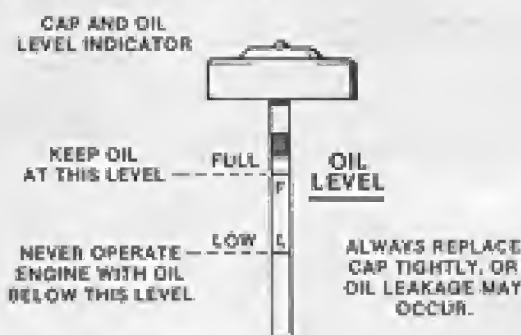


FIGURE 2. CHECKING OIL LEVEL

Be sure to fill the crankcase with oil to the "FULL" mark on the oil level indicator. Use oil with the API (American Petroleum Institute) designation SE or SE/CC. Oil should be labeled as having passed MS Sequence Tests (also known as having passed ASTMG-1V Sequence Tests). Refer to oil chart for recommended viscosity and temperature.

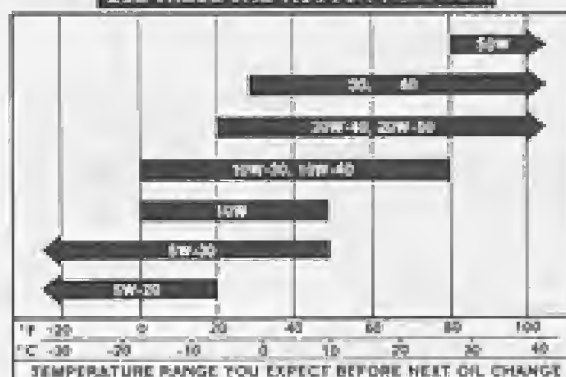
Oil consumption may be higher with a multigrade oil than with a single grade oil if both oils have comparable viscosities at 210° F (99 °C). Therefore, single grade oils are generally more desirable, unless anticipating a wide range of temperatures.

Use of the same grade and quality of oil as that used in your recreational vehicle engine is acceptable as long as unit is serviced regularly and oil meets requirements shown in chart.

### WARNING

Do NOT check oil while the generator set is operating. Hot oil could cause burns by blowing out of oil fill tube due to crankcase pressure.

## USE THESE SAE VISCOSITY GRADES



Check oil level daily and change oil every 100 normal operating hours. See Figure 3 for location of oil drain. If operating in extremely dusty or dirty conditions, the oil might have to be changed sooner. When adding oil between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed.

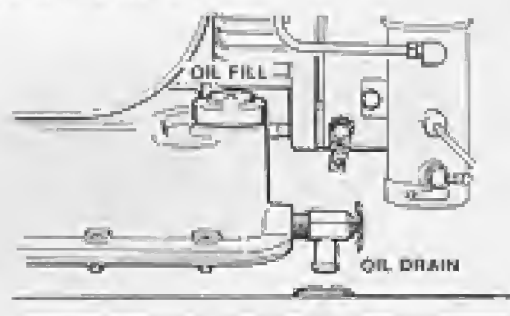


FIGURE 3. OIL DRAIN AND FILL

## RECOMMENDED FUEL

Use clean, fresh, unleaded or regular grade gasoline. Do not use highly leaded premium fuels. Using unleaded gasoline results in reduced valve and carbon cleanout maintenance.

If the use of unleaded gasoline is desired, use regular gasoline for the first 25 hours to allow the rings to seat well for best performance. Then use unleaded gasoline thereafter.

If regular gasoline is used continually, carbon and lead deposits must be removed from the cylinder heads as required because of engine power loss. Unleaded gasoline may be used safely after lead deposits have been removed.



**WARNING**

Leakage of gasoline in or around the compartment is a definite hazard. The ventilation system should provide a constant flow of air to expel any accumulation of fuel vapor while the vehicle is in transit. Compartments must be vapor tight to the exterior to keep fumes from within the vehicle.

**STARTING**

Push the start-stop switch to the start position. Release the switch when engine starts. If engine fails to start, inhibitor oil used at the factory may have fouled the spark plugs. Remove the plugs, clean in a suitable solvent, dry thoroughly and re-install. Heavy exhaust smoke when the engine is first started is normal and caused by the inhibitor oil.

**STOPPING**

Push the start-stop switch to the stop position and hold until unit stops completely.

**BREAK-IN PROCEDURE**

Controlled break-in with the proper oil and a conscientiously applied maintenance program will help to assure satisfactory service from your Onan electric generating set. Break-in as follows:

1. One half hour at 1/2 load (with one air conditioner) and approximately 500 watts additional load.
2. One half hour at 3/4 load (with one air conditioner) and approximately 1500-2000 watts additional load.
3. Change crankcase oil after the first 50 hours of operation.

**APPLYING LOAD**

If practical, allow set to warm up before connecting a heavy load. Continuous generator overloading may cause high operating temperatures that can damage the windings. Keep the load within nameplate rating.

**LOAD CONNECTIONS**

1. Generator set load wires M1, and M2 terminate within the junction box. Connect and join wires within junction box in an approved manner for desired voltage code. See Figure 4.
2. Wires must be adequate size, properly insulated and supported.
3. Mount switches and controls securely to prevent damage from vibration and road shocks. All switches must be vibration proof to prevent accidental opening or closing while the vehicle is in motion.
4. All wiring must meet applicable local electrical codes. Have a qualified electrician install and inspect the wiring.

**EXERCISE**

Infrquent use results in hard starting. Operate the generator set one 30-minute period each week. Run longer if battery needs charging. Exercising for one long period each week is better than several short periods.

**BATTERY CHARGING**

The battery charge rate is controlled by a fixed value resistor that allows a trickle charge rate of 1 - 1-1/2 amps under all conditions.

**HIGH OPERATING TEMPERATURES**

1. See that nothing obstructs air flow to and from the set.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.
3. Keep ignition timing properly adjusted.

**LOW OPERATING TEMPERATURES**

1. Use correct SAE oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move vehicle to a warm location.
2. Use fresh gasoline. Protect against moisture condensation. Below 0°F (-18°C), adjust carburetor main jet for a slightly richer fuel mixture.
3. Keep ignition system clean, properly adjusted and batteries in a well charged condition.
4. Partially restrict cool airflow, but use care to avoid overheating.

A carburetor air preheater kit is available for cold weather operation below 45° F (7° C), which helps prevent carburetor icing. Order Kit No. 140-1673.

**EXTREMELY DUSTY OR DIRTY**

1. Keep unit clean. Keep cooling surfaces clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 50 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.
6. Clean generator brushes, slip rings, and commutator, *do not* remove normal dark brown film. *Do not* polish.

**HIGH ALTITUDE OPERATION**

For operation at altitudes of 2500 feet (775 m) above sea level, close carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio (refer to the **ADJUSTMENTS** section). Maximum power will be reduced approximately four percent for each 1000 feet (310 m) above sea level after the first 1000 feet.

# POWER REQUIREMENTS FOR APPLIANCES

Appliance or Tool	Approximate Running Wattage
Refrigerator .....	600-1000
Electric broom .....	200-500
Coffee percolator .....	550-700
Electric frying pan .....	1000-1350
Hair dryer .....	350-500
Electric stove (per element) .....	350-1000
Electric iron .....	500-1200
Radio .....	50-200
Electric water heater .....	1000-1500
Space heater .....	1000-1500
Electric blanket .....	50-200
Television .....	200-600
Electric drill .....	250-750
Battery charger .....	Up to 800
Electric water pump .....	500-600
Air Conditioner .....	1400-2200
Converter .....	300-350
Microwave oven .....	700-1500

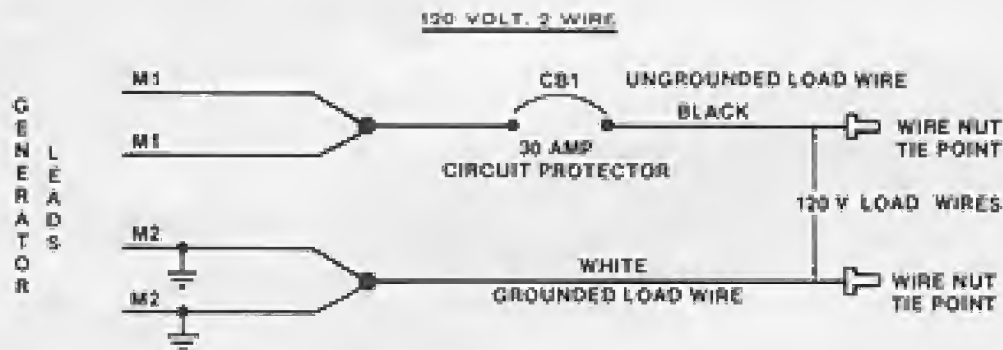


FIGURE 4. SINGLE-PHASE, "1R" VOLTAGE CODE GENERATOR CONNECTIONS

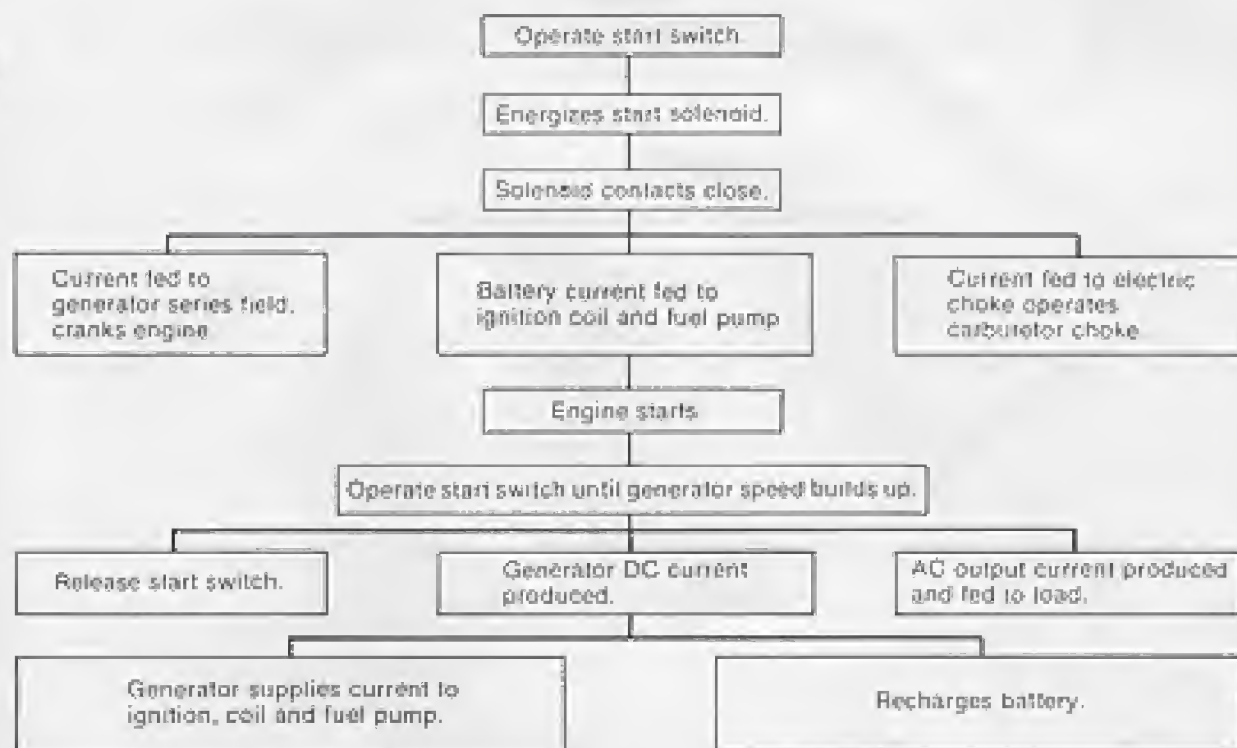


FIGURE 5. SEQUENCE OF OPERATION

### SEQUENCE OF OPERATION

Figure 5 shows the operation sequence of the BFA electric generating set.



# ENGINE TROUBLESHOOTING

TROUBLE															GASOLINE ENGINE TROUBLESHOOTING GUIDE															CAUSE														
Water & Generator	Ignition Switch	Ignition Coil	Ignition Points	Ignition Wires	Ignition Timing	Ignition Advance	Ignition Retard	Ignition Lock	Ignition Kill	Ignition Stop	Ignition Stop	Ignition Stop	Ignition Stop	Ignition Stop																														
															STARTING SYSTEM																													
															Lack of Corroded Battery Connection																													
															Loss of Discharged Battery																													
															Faulty Motor																													
															Faulty Start Interlock																													
															IGNITION SYSTEM																													
															Ignition Timing Wrong																													
															Wrong Spark Plug Gap																													
															Worn Points or Improper Gap Setting																													
															Bad Ignition Coil or Condenser																													
															Faulty Spark Plug Wires																													
															FUEL SYSTEM																													
															Out of Fuel - Check																													
															Lean Fuel Mixture - Readjust																													
															Rich Fuel Mixture or Choke Stuck																													
															Engine Flooded																													
															Poor Quality Fuel																													
															Dirty Carburetor																													
															Dirty Air Cleaner																													
															Dirty Fuel Filter																													
															Defective Fuel Pump																													
															INTERNAL ENGINE																													
															Worn Valve Clearance																													
															Broken Valve Spring																													
															Valve or Valve Seal Leaking																													
															Piston Rings Worn or Broken																													
															Worn Bearing Clearance																													
															COOLING SYSTEM (AIR COOLED)																													
															Poor Air Circulation																													
															Clog in Air Cooling Fins																													
															Blown Head Gasket																													
															COOLING SYSTEM (WATER COOLED)																													
															Insufficient Coolant																													
															Faulty Thermostat																													
															Worn Water Pump or Pump Seal																													
															Water Passages Restricted																													
															Defective Gaskets																													
															Blown Head Gasket																													
															LUBRICATION SYSTEM																													
															Defective Oil Gauge																													
															Excess Valve Stem																													
															Faulty Oil Pump																													
															Dirty Oil or Filter																													
															Oil Too Light or Diluted																													
															Oil Level Low																													
															Oil Too Heavy																													
															Dirty Crankcase Breather Valve																													
															THROTTLE AND GOVERNOR																													
															Linkage Out of Adjustment																													
															Linkage Worn or Disconnected																													
															Governor Spring Adjustment Too Great																													
															Linkage Binding																													

# MAINTENANCE

## BATTERY CARE

To increase battery life, the operator can perform a number of routine checks and some preventive maintenance.

1. Keep the battery case clean and dry.
2. Make sure the battery cable connections are clean and tight. Use a terminal puller when removing cables for any reason.
3. Coat the battery terminals with a mineral grease or petroleum jelly to reduce corrosion and oxidation.
4. Identify each battery cable to be positive or negative before making any connection. Always connect the ground (negative) cable last.
5. Maintain the electrolyte level by adding water (drinking quality or better) as needed for filling to split level marker. (The water ingredient of the electrolyte evaporates, but the sulphuric acid ingredient remains. Therefore, add water, not electrolyte.
6. Avoid overcharging when recharging. Stop the boost charge when the specific gravity is 1.260 and the electrolyte is 80°F (26.7°C).

## ELECTRIC FUEL PUMP

Service of the fuel pump is limited to cleaning the filter. Every 100 hours, drain the fuel pump and check the filter element. Turn the hex nut on the base of the pump to gain access to the filter element. If the element appears dirty, replace it. Be sure to replace gaskets when reassembling. (Figure 6)

## COOLING SYSTEM

The generator set is cooled by a flywheel blower fan which pulls air over the cylinders and cooling fins. The air path is directed by sheet metal shrouds and plates. These shrouds and plates must always be installed properly so unit does not overheat.

Check and clean (if necessary) the cooling fins at least every 200 hours of operation. Remove any dust, dirt or oil which may have accumulated. Check compartment air inlet and generator set air outlet for buildup of dirt, chaff, etc.

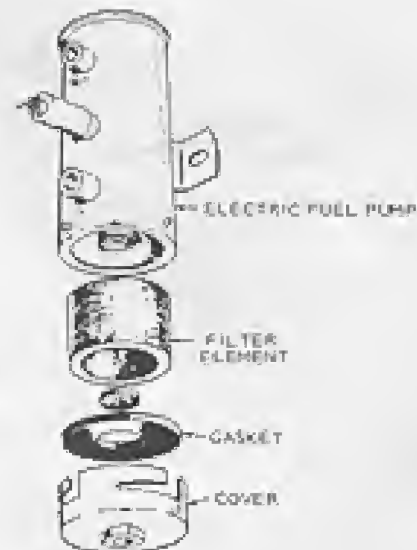


FIGURE 6. QNAN FUEL PUMP

## AIR CLEANER ELEMENT

Check and clean element at least every 100 hours. Loosen wing nut to remove. Clean by tapping base lightly on a flat surface. Replace element at least every 200 operating hours; clean or replace more often in dusty conditions. See Figure 7.

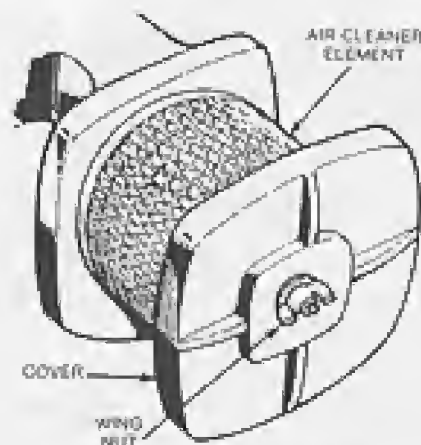


FIGURE 7. AIR CLEANER ELEMENT

## SPARK PLUGS

Replace spark plugs every 100 hours or at least once a year. A badly leaded plug will cause misfiring, poor operation or stopping when a load is applied.

- Black deposits indicate a rich mixture.
- Wet plug indicates misfiring.
- Badly or frequently fouled plug indicates the need for a major tune-up.

Each time the spark plugs are removed, inspect, clean and regap (Figure 8). If the plug looks discolored or has fouled, replace it.

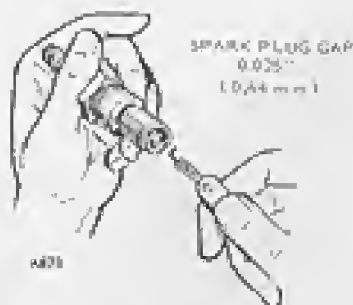


FIGURE 8. CHECKING SPARK PLUG GAP

## GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation, clean the joints and lubricate as shown in Figure 9. Also inspect the linkage for binding, excessive slack and wear.

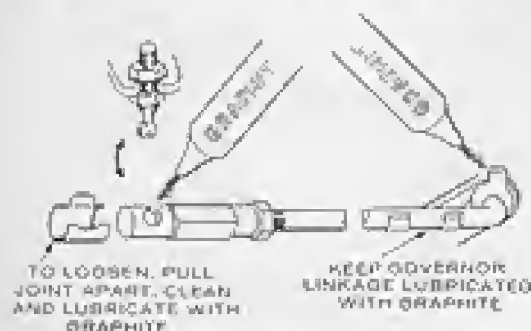


FIGURE 9. GOVERNOR LINKAGE

## OUT-OF-SERVICE PROTECTION

Protect a generator set that will be out of service for more than 30 days from damage caused by rust or corrosion. Use the following procedure to properly protect the set.

1. Run the generator set with at least a 50% load until thoroughly warm (usually about 1 hour).
2. Turn off fuel supply and allow the engine to run out of fuel. Also operate the choke manually as

the engine stops to help drain the carburetor completely.

3. Drain the oil from oil base while engine is still warm. Replace the oil filter if so equipped. Replace drain plug and refill. Attach a warning tag stating type and viscosity of oil used.
4. Remove spark plugs. Pour 1 ounce of rust inhibitor oil (or SAE #10) into each cylinder. (Spray cans work well for this application). Turn engine over by hand at least 2 complete revolutions. Replace the spark plugs.
5. Replace the air cleaner at least on an annual basis.
6. Plug the exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
7. Clean and oil all exposed engine parts including carburetor and governor linkage.
8. Wipe generator brushes, slip rings, housing, etc. Do not apply any lubricant or preservative.
9. Remove the battery and store in a cool dry place. Coat the battery terminals and cable connections with vasoline or grease to prevent any corrosion. Recharge the battery at least monthly or maintain with a trickle type battery charger.
10. Provide a suitable cover if the unit is exposed to the elements.

## RETURNING THE UNIT TO SERVICE

1. Remove the cover and all protective wrapping. Wipe the oil film off all exposed engine parts. Remove the plug from the exhaust outlet.
2. Visually inspect the unit for any damage. Check to be sure the carburetor and governor linkage are free. Remove the generator end bell band and check to be sure the brushes work freely in their holders.
3. Check the tag to ensure oil of the proper brand and grade has been installed. Check the oil level.
4. Install the battery (be sure battery is fully charged), observing proper polarity. Ground is negative.
5. Remove spark plugs, clean and gap. Turn the engine over by hand several times. Reinstall spark plugs.
6. Turn on fuel, disconnect electric fuel pump lead and electric fuel solenoid shut-off lead if unit is so equipped. Jumper the fuel pump and electric fuel solenoid shut-off leads to the battery to prime the unit. Reconnect the leads.
7. Remove all load and start the generator set at the unit. Initial start may be slow due to oil or rust inhibitor in the cylinders. Excessive smoke and rough operation will occur until the oil or rust inhibitor is burned off.
8. Apply a 50% load after the set runs smooth. Allow the generator set to warm up (1 hour) with the load connected. Check speed and voltage.
9. Unit is now ready for service.



## GENERATOR MAINTENANCE

The generator normally needs little care other than a periodic check of the brushes, commutator and collector rings. If a major repair job on the generator should become necessary, have the equipment checked by a competent electrician who is thoroughly familiar with the operation of electric generator equipment.

### Brush Replacement

Install new brushes when the old ones are worn to the dimensions shown in Figure 10. Remove the end bell band to expose the brush holders. Remove the three screws holding each brush holder in place (Figure 10). Remove the old brushes and clean the holders so the new brushes can move easily in their holders. Install the new brushes in the same manner as the old ones. Always use the correct brush as listed in the PARTS CATALOG. Never substitute a brush which may appear to be the same for it may have different characteristics. New brushes are shaped to fit and seldom need sanding to seat properly. If some brush sparking occurs after replacing brushes, run the set under a light load until the brushes wear to a good seat.

Collector rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright newly machined appearing surface. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#200) may be used to remove slight roughness.

## ASSEMBLY TORQUES

BOLT TORQUE	FT.-LB.
Gearcase Cover .....	8-10
Cylinder Head Stud Nuts (Cold) .....	18-19
Rear Bearing Plate Screws .....	25-28
Connecting Rod Bolt .....	14-16
Flywheel Cap Screw .....	35-40
Other 5/16" Cylinder Block	
Stud and Nuts .....	8-10
Oil Base Mounting Screws .....	18-23
Manifold Mounting Screws .....	18-23
Oil Pump .....	7-9
Exhaust Manifold .....	18-23

### EXHAUST SPARK ARRESTER

Exhaust spark arresters are necessary for SAFE OPERATION. All require periodic clean-out (every 50 to 100 operating hours) to maintain maximum efficiency. Some state and federal parks require them.

To clean spark arrester remove pipe plug in bottom of muffler. Run set under load for 5 minutes. Replace plug.

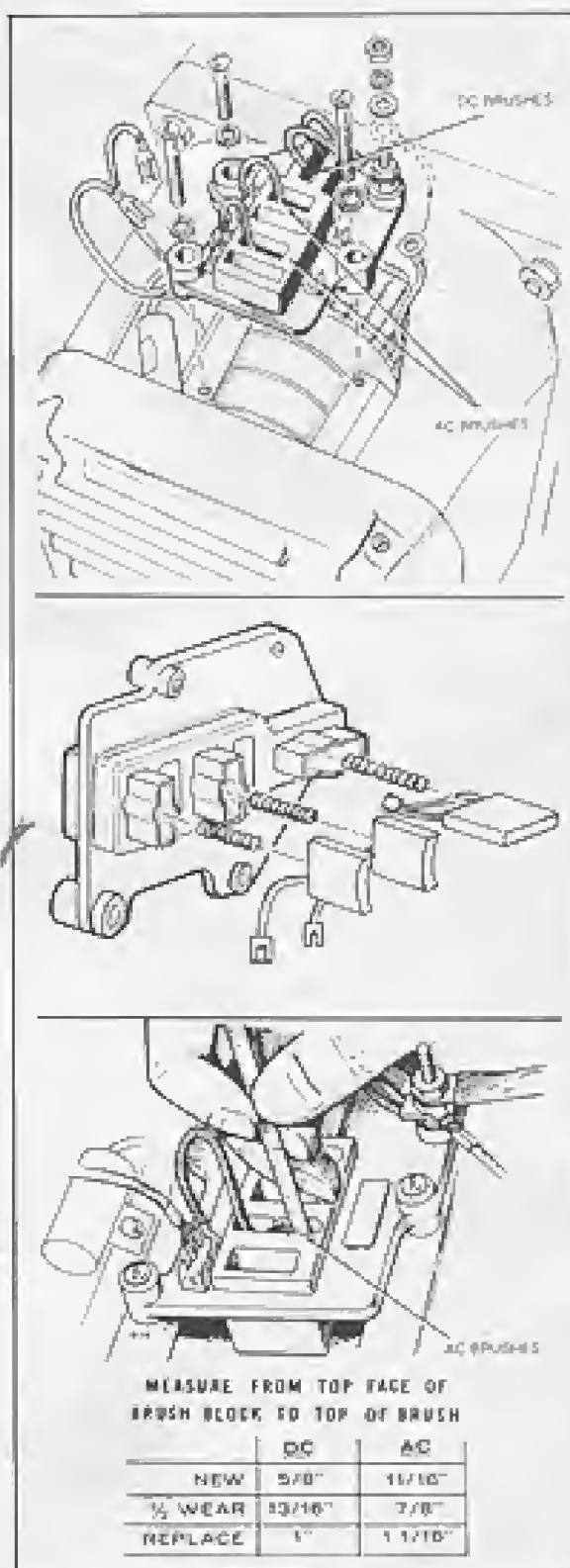


FIGURE 10. BRUSH LENGTH

# PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The following schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check

the condition of the crankcase oil, the filters, etc. frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest authorized Onan dealer.

## WARNING

Always allow generator set to cool off before performing any maintenance or installation work on the set. Working on a hot set could cause severe burns.

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	50	100	200	400
General Inspection	X1				
Check Oil Level	X				
Check Battery Electrolyte Level		X			
Change Crankcase Oil			X2		
Check Air Cleaner			X2		
Check Spark Plugs			X4		
Check Breaker Points			X3		
Change Oil Filter			X2		
Clean Cooling Fins				X2	
Replace Breaker Points				X4	
Clean Crankcase Breather				X2	
Replace Air Cleaner				X2	
Remove Carbon Deposits from Heads				X	
Adjust Tappets					X
Replace Fuel Filter					X4
Clean Carburetor					X
Check Generator Brushes (Replace if Necessary)	As Required				

X1 - With set running, visually and audibly check exhaust system for leaks.

X2 - Perform more often in extremely dusty conditions.

X3 - Replace if necessary.

X4 - Replace annually or prior to storage.

## WARNING

All exhaust system connections **MUST** be checked regularly for any leaks and tightened as necessary. Do NOT terminate exhaust pipe under vehicle or near any window or door openings. Inspect the vapor tight seals around all openings made in the set's compartment for wiring, conduit, etc., to prevent entrance of any noxious fumes to motor home interior.

# ADJUSTMENTS

Satisfactory generator set performance depends on correct adjustments. If trouble develops, follow an orderly procedure to determine the cause before making changes in adjustments. Refer to *ENGINE TROUBLESHOOTING* and *PERIODIC SERVICE GUIDES* for additional help.

## CARBURETOR

The BFA "RV" generator set carburetor has two mixture adjustments, an idle mixture which affects operation mainly at no load and a main (power) adjustment which affects operation at maximum load (Figure 11). If your generator set has a "hunting" (sudden surges and drops in speed) condition at no load or full load and cannot be corrected by carburetor adjustments, check governor, linkage and adjustment (see Governor Adjustments). A hunting condition at no load can usually be corrected by an idle mixture adjustment.

**CAUTION** When determining fuel mixture settings, never force the fuel mixture adjustment needles against their seats (damages the seats and needles).

## CARBURETOR ADJUSTMENTS

Start generator set and allow it to warm up for at least 10 minutes before making any adjustments. Remove all AC loads and connect a plug-in-type AC voltmeter into one of the receptacles in the coach. When procedure below calls for full load, turn on appliances or use an Onan load test panel. The first two adjustments are made with the set not running. Turn unit off—proceed as follows:

1. Turn idle mixture screw out (counterclockwise) 1/2 to 3/4 turn from seated position.
2. Turn main mixture screw 1-1/4 to 1-1/2 turns out (counterclockwise) from seated position.
3. Start set and adjust governor spring setting so engine speed is 1800 RPM at no load (62 hertz or 130 volts).
4. Hold back governor arm so that throttle lever rests on throttle stop screw. Adjust idle stop screw to 1500 RPM (50 hertz or 100 volts). Release governor arm.
5. Adjust idle mixture screw to highest RPM or voltage. Readjust governor spring setting so engine speed is 1800 RPM at no load (62 hertz or 130 volts).
6. Apply full load to generator and adjust main mixture screw to highest RPM or voltage. Readjust governor spring setting so engine speed is 1770 RPM at full load (59 hertz or 110 volts).
7. Remove and add load several times to check for a governor hunting condition. Readjust governor spring setting if required.

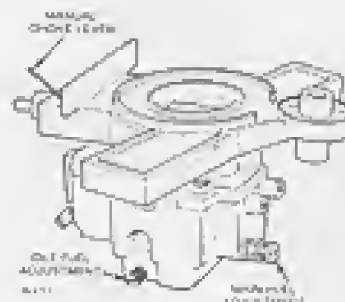


FIGURE 11. CARBURETOR FUEL MIXTURE ADJUSTMENTS

## THROTTLE STOP SCREW

The throttle stop screw is located on the base of the carburetor (opposite side from main power adjustment needle) near the crankcase breather valve. It must be adjusted to obtain 56 hertz at no load with the throttle closed as far as possible (throttle shaft lever touching adjustment screw). See Figure 12.

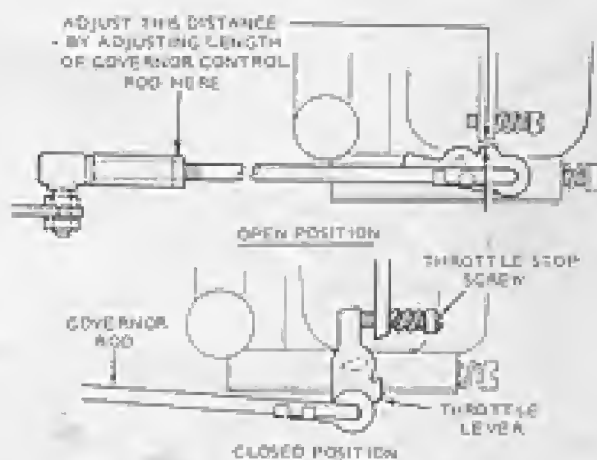


FIGURE 12. THROTTLE STOP SCREW SETTING

## CARBURETOR FLOAT ADJUSTMENT

1. Normal operation seldom requires any adjustment of the float level. Disconnect throttle control, choke leads, air cleaner inlet hose and fuel line from carburetor.
2. Remove the four bolts that hold the intake manifold assembly in place and remove the complete carburetor and intake manifold assembly as one unit. Then remove carburetor from intake manifold for easier handling when checking float level.



3. Remove the four phillips head screws on the top of the carburetor and lift it off.
  4. Invert the carburetor and check the float setting (see Figure 13). The float should have a  $0.07 \pm 0.02$  inch ( $1.8 \pm 0.5$  mm) clearance from the machined mating surface (without gasket). Bend the float tab as required.
  5. If it is necessary to reset the float level, loosen the screw near float valve axle (pin) and bend the float arm near float valve axle (pin) to position float flush with top edge of carburetor float bowl. See Figure 13.
- CAUTION** If float adjustment is necessary, be careful not to lose the buoyancy spring or the tension spring on the viton lip float needle and seat assembly.
6. Reassemble carburetor and reinstall carburetor on intake manifold assembly and then replace complete assembly on the engine.
  7. Check carburetor for proper operation.

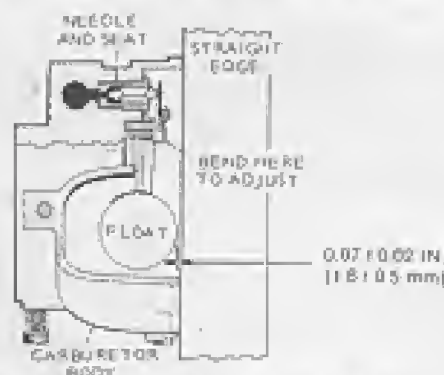


FIGURE 13. CARBURETOR FLOAT SETTING

## GOVERNOR ADJUSTMENTS

If carburetor and the following governor adjustments have already been made and the governor action is still erratic, replace the governor spring (Figure 14) with a new one and readjust the governor. Springs lose their calibrated tension through fatigue after long usage.

Before making governor adjustments, run the unit about 15 minutes under light load to reach normal operating temperature. (If governor is completely out of adjustment, make a preliminary adjustment at no load to first attain a safe voltage operating range).

Engine speed determines the output voltage and current frequency of the generator. By increasing the engine speed, generator voltage and frequency are increased, and by decreasing the engine speed, generator voltage and frequency are decreased. An accurate voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor. A small speed drop not noticeable without instruments will result in an objectionable voltage drop. The engine speed can be checked with a tachometer.

A binding in the bearings of the governor shaft, in the ball joint, or in the carburetor throttle assembly will cause erratic governor action or alternate increase and decrease in speed (hunting). A lean carburetor adjustment may also cause hunting. Springs of all kinds have a tendency to lose their calibrated tension through fatigue after long usage. If all governor and carburetor adjustments are properly made, and the governor action is still erratic, replacing the spring with a new one and resetting the adjustments will usually correct the trouble.

1. Adjust the carburetor idle needle with no load connected.
2. Adjust the carburetor main jet for the best fuel mixture while operating the set with a full rated load connected.
3. Adjust the length of the governor linkage and check linkage and throttle shaft for binding or excessive looseness.
4. Adjust the governor spring tension for rated speed at no load operation.
5. Adjust the governor sensitivity.
6. Recheck the speed adjustment.
7. Set the carburetor throttle stop screw.

**Linkage:** The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft assembly is adjusted by rotating the ball joint. Adjust this length so that with the engine stopped and tension on the governor spring, the stop on the throttle shaft assembly almost touches the throttle stop screw housing on side of carburetor (one more turn of governor ball joint would allow throttle shaft linkage to rest against stop screw housing). See Figure 12.

**Speed Adjustment:** With the warmed-up unit operating at no load, adjust the tension of the governor spring. Refer to the Voltage Chart and the Speed Chart. Turn the speed adjusting nut to obtain a voltage and speed reading within the limits shown.

**Sensitivity Adjustment:** Refer to the Governor Adjustment illustration, and to the Voltage and Speed Charts. Check the voltage and speed, first with no load connected and again with a full load. Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition.

To increase sensitivity (closer regulation), shift the spring toward the governor shaft.

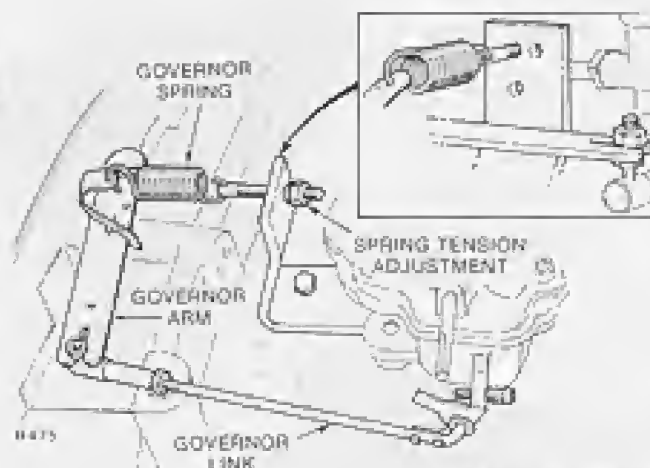


FIGURE 14. GOVERNOR ADJUSTMENTS

## ELECTRIC CHOKE

If extremes in starting temperatures require a readjustment of the choke, loosen slightly the two cover retaining screws. See Figure 15. For less choking action, turn the cover assembly a few degrees in a clockwise direction. For more choking action, turn counterclockwise. Retighten the cover screws. Choke may be closed manually if desired to adjust choke settings or for troubleshooting purposes.

If the engine starts and runs roughly after a minute or two of operation, the choke is set too rich. If the engine starts, and assuming that fuel, ignition and compression are adequate, but the engine sputters or stops before it warms up, the choke is set too lean.



AVERAGE CHOKE SETTING	
AMBIENT TEMP (°F)	CHOKE OPENING
58 (14°C)	closed
66 (19°C)	1/4 open
72 (22°C)	1/2 open
76 (24°C)	3/4 open
82 (28°C)	open

FIGURE 15. CHOKE ADJUSTMENT

## BREAKER POINTS AND IGNITION TIMING

The correct point gap setting is .021 cold (0.53 mm) and should be adjusted as follows:

1. Remove cover by loosening screw and lift off.

VOLTAGE CHART FOR CHECKING GOVERNOR REGULATION	120 VOLT 1 PHASE 2 WIRE
MAXIMUM NO-LOAD VOLTAGE	133
MINIMUM FULL-LOAD VOLTAGE	108

SPEED CHART FOR CHECKING GOVERNOR REGULATION	
MAXIMUM NO-LOAD SPEED (RPM)	1895
HERTZ (CURRENT FREQUENCY)	63
MINIMUM FULL-LOAD SPEED (RPM)	1770
HERTZ	54

2. To set the point gap turn the engine crankshaft with rotation until the maximum breaker point gap is obtained.
3. Using an allen head wrench, adjust set screw (9) for .021 (0.53 mm). Measure point gap with a flat thickness gauge.

Make sure feeler gauge is clean and free of any grease, oil or dirt. See Figure 16.

The timing is adjusted during initial engine assembly and is fixed by the point gap adjustment. No other adjustment or alignment is necessary. A .021 point gap is equivalent to approximately 21° BTC.

4. Replace point box cover.

The ignition adjustments should be made with the engine in a static condition and cold.

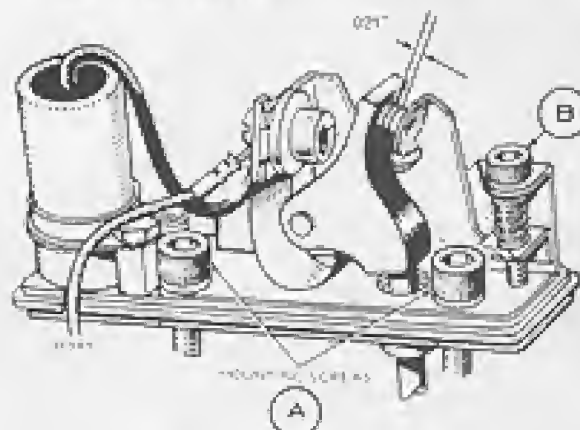


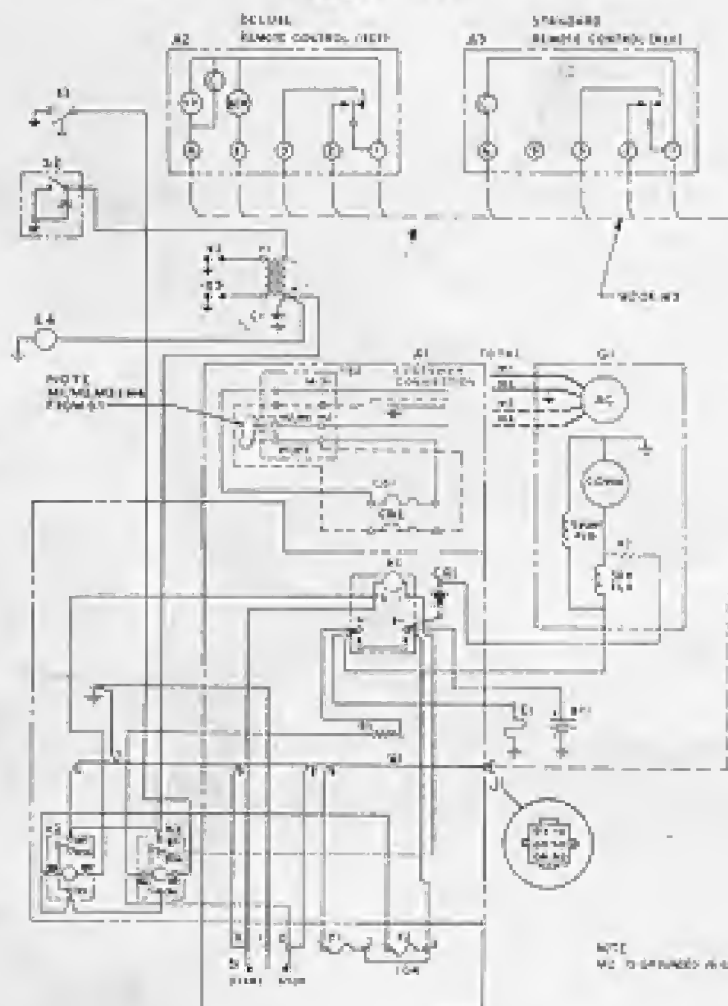
FIGURE 16. TOP ADJUST POINTS

# CONTROL TROUBLESHOOTING

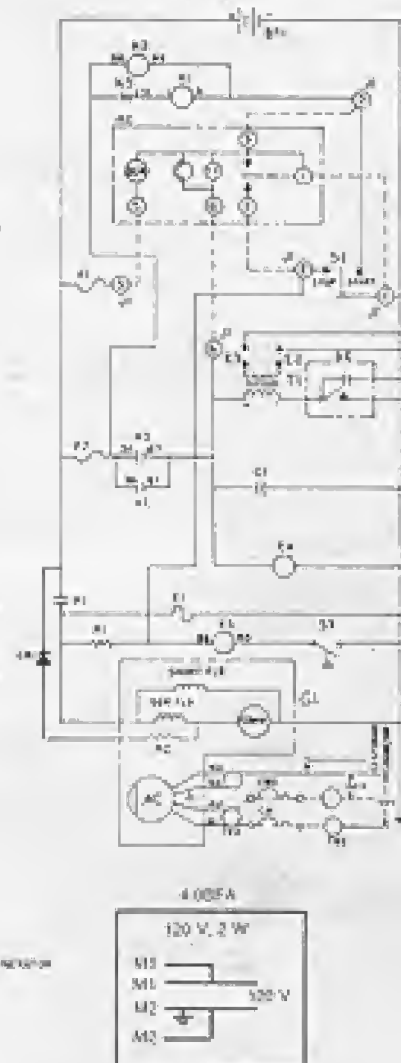
PROBLEM	PROBABLE CAUSE	REMEDY
FAILS TO CRANK	1. Bad Battery Connection	1. Clean and tighten all battery and cable connections.
	2. Low Battery	2A. Check specific gravity. Recharge or replace battery if necessary. 2B. Reverse current diode (CR1) may be shorted or open causing a drain on the battery. R2 may be open.
	3. Faulty Start Solenoid (K1)	3A. Check for Battery Voltage at K1 "1" terminal. 3B. Push start switch. Check start solenoid "S1" terminal voltage to ground. When battery voltage at start solenoid "B1" terminal is present, battery voltage should also appear at "S1" terminal; if not, replace start solenoid.
	4. Faulty Start Switch	4. Jumper switch (#3 terminal) to ground. If solenoid energizes, replace switch.
CRANKS SLOWLY	1. Bad Battery Connection	1. See 1 above (FAILS TO CRANK).
	2. Low Battery	2. See 2 above (FAILS TO CRANK).
CRANKS BUT WON'T START	1. Blown Fuse (F2)	1. Replace fuse (F2) on control.
	2. Faulty Fuel Solenoid Or Fuel Pump  On later models, fuel solenoid is an integral part of fuel pump.	2. Fuel solenoid must open during cranking and running. Check by removing steel line from carburetor and crank engine. If fuel solenoid is open, fuel will pulsate out of this line. If it does not, the fuel solenoid and fuel pump must be checked separately to determine defective part. <div><b>WARNING</b> Use extreme care for this test. Direct fuel flow into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.</div>
	3. Faulty Ignition	3. Check to see if points open and close during cranking. If they do not open and close, adjust and set points. Plug and plug wires must be in good condition. Voltage at ignition coil negative terminal (-) must alternate from +12 volts to zero volts as points open and close during engine cranking.
	4. Inoperative Choke	4. With engine not running, check choke vane movement by pushing choke lever arm. Choke must be in closed position with cold engine, and must be free to move against bimetal spring. As engine warms up, bi-metal spring relaxes and allows choke vane to open fully. The lever will pulsate as engine warms up. See ADJUSTMENT section.
	5. Faulty Crank Ignition Relay (K2)	5. Check voltage from relay terminal "4" to ground while cranking unit. Battery voltage should appear at this terminal. If not, check for voltage at relay terminals "1" and "2". If battery voltage is present at terminals 1 and 2, but not at 4, replace relay. If not voltage appears at terminals 1 and 2 on relay while cranking, check wiring between start solenoid (K1) and crank ignition relay (K2).
UNIT STARTS, BUT STOPS IMMEDIATELY AFTER RELEASING START SWITCH S1	1. Resistor R1 may be open 2. Run Ignition Relay K3 3. Low Oil Level 4. S3 Low oil pressure switch may be defective	1. Check voltage on both sides of R1. With set running, voltage should be 34-32 volts DC. 2. Check voltage on both sides of K3. Should be 12 volts. 3. Check oil level. If low or empty, refill to proper level. 4. Check S3. Switch should close with set running at 10 lbs. minimum oil pressure.
UNIT RUNS THEN STOPS	1. Low Oil Level	1. Check oil level. If low or empty, refill to proper level.
UNIT RUNS BUT SURGES	1. Stuck Choke	1. See 4 above (CRANKS BUT WON'T START).
	2. Governor Not Adjusted Properly	2. Readjust governor.
UNIT STOPS	1. Faulty Ignition	1. See 3 above (CRANKS BUT WON'T START).
	2. Out of Fuel	2. Refill fuel tank.
	3. Low Oil Level	3. Check oil level. If low or empty, refill to proper level.
REMOTE RUNNING TIME METER OR GENERATOR LAMP INOPERATIVE	1. Blown Fuse (F1)	1. Replace F1 fuse on control.



## WIRING DIAGRAM



## SCHEMATIC



A1 ..... Control Assembly  
 A2 ..... Deluxe Remote Control  
 A3 ..... Standard Remote Control  
 BT1 ..... 12 Volt Battery  
 CB1 ..... Circuit Breaker  
 CB2 ..... Circuit Breaker  
           (when used)  
 CR1 ..... Reverse Current Diode  
           (prevents battery discharge  
           when unit is shut down)  
 E1 ..... Onan Choke  
 E2, E3 ..... Spark Plugs

E4 ..... Electric Fuel Pump  
 F1, F2 ..... Fuse (5-amp, 32 volt)  
 G1 ..... Generator  
 K1 ..... Start Solenoid  
 K2 ..... Crank Ignition Relay  
 K3 ..... Ignition Run Relay  
 R1 ..... Battery Charging Resistor  
           (fixed value)  
 S1 ..... Start-Stop Switch  
 S2 ..... Breaker Points Assembly  
 S3 ..... Low Oil Pressure Switch  
 T1 ..... Ignition Coil

# REMOTE ACCESSORIES

## INSTALLING STANDARD OR DELUXE REMOTE START CONTROLS 300-0985 AND 300-0986

The standard control includes a start-stop switch and indicator lamp. The deluxe control contains these items plus a running time meter and a battery condition meter. Install as follows:

1. Select control location. Using Figure 17 or 18 as a guide, drill screw holes and cut hole to accommodate remote switch in dash panel.
2. Following national local electrical codes and using # 18 or larger insulated wires of predetermined length, connect remote control to generator set. Ensure that leads from remote control connect to corresponding terminals on generator set. Refer to Figure 19 for wiring connections.

**CAUTION** Do not route DC wires for remote control through conduit containing AC load wiring. Induced voltages may cause erratic operation.

3. Insert remote control in hole cutout and secure with woodscrews supplied with switch.

**WARNING**

Seal all holes that might allow noxious gases to enter motor home.

**CAUTION**

Ensure that leads from remote switch connect with corresponding terminals on generator set.

For sets without remote connector plug, connect terminals 1, 2, and 3 to corresponding terminals on generator set terminal block. Connect terminal #5 (if used) to B+ (on terminal block) or to battery connection on start solenoid. This connection should be protected with a 5 amp fuse. Connect terminal #6 to positive terminal on ignition coil and protect with a 5 amp fuse.

4. When wiring is complete, check for proper operation by starting and stopping set at the set control and by the remote start switch.

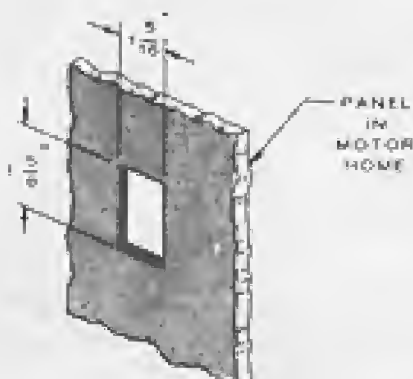


FIGURE 17. MOTOR HOME CUTOUT  
FOR 300-0985 STANDARD  
CONTROL PANEL

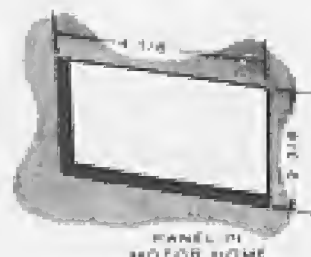


FIGURE 18. MOTOR HOME CUTOUT FOR  
300-0986 DELUXE CONTROL  
PANEL

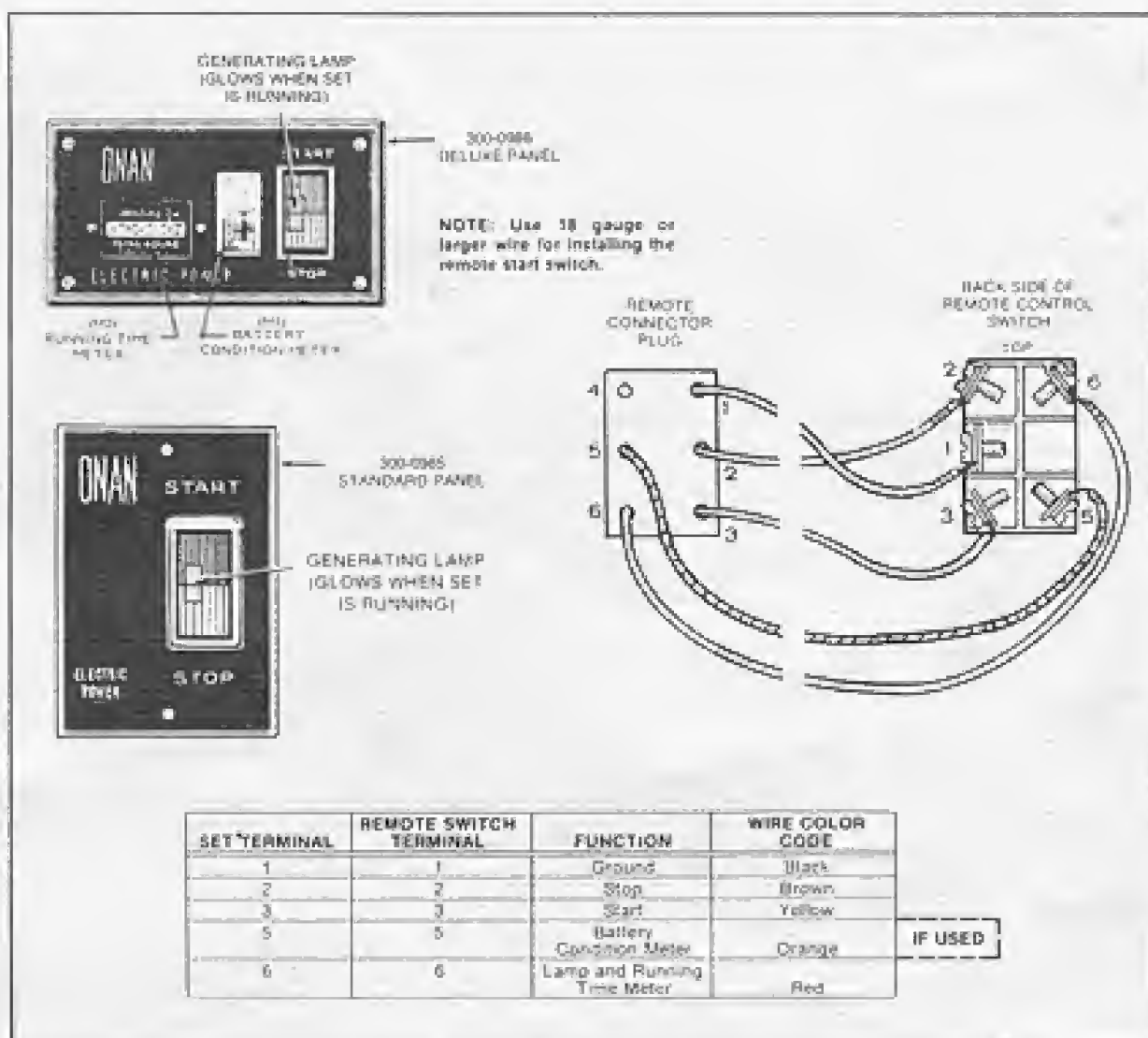


FIGURE 19. WIRING CONNECTIONS FOR 300-0985 AND 300-0986 REMOTE CONTROLS

Onan Corporation  
A Subsidiary of  
McGraw-Hill Company  
1400 73rd Avenue NE  
Minneapolis, MN 55432

612 574-5000  
Telex 29 6476 (U.S.)  
Telex 29 6856 (outside U.S.)  
TWX 610 576-3813  
Cable ONAN